

DOCUMENT RESUME

ED 243 434

IR 011 043

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TITLE Conceptual Tools for R&D on Applications of Microcomputers to Individualization.
PUB DATE 23 Jan 84
NOTE 13p.; Paper presented at the Annual Meeting of the Association for Educational Communications and Technology (Dallas, TX, January 20-24, 1984). For proceedings, see IR 011 020.
PUB TYPE Viewpoints (120) -- Speeches/Conference Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Ability; *Cognitive Style; Educational Media; *Educational Technology; Instructional Design; Instructional Development; *Media Research; *Microcomputers; Programed Instructional Materials; *Research Needs; *Student Characteristics; Technological Advancement
IDENTIFIERS Computer Uses in Education

ABSTRACT

This paper introducing a symposium--Cognitive Style and Microcomputers: A Review and Synthesis of Current and Needed Research and Development--presents issues attendant to research and development in cognitive styles and microcomputer uses within the context of instructional technology, with emphasis on the relationship of cognitive style to learners' general ability and prior learning. In examining needs for research in and on microcomputers in education, the heritage of programmed instruction and teaching machine research of the 1950's and 1960's is reviewed as that work relates to currently available practitioner's tools in instructional design and development. A plea for increased basic research on learner characteristics and the instructional media attributes of currently available high technology concludes the paper. (Author/LMM)

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Conceptual Tools for R & D on Applications
of Microcomputers to Individualization

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Paper presented at the annual meeting of the Association for
Educational Communications and Technology (AECT)
Dallas, Texas, January 23, 1984

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Abstract

This paper introduces the symposium, Cognitive Style and Microcomputers: A Review and Synthesis of Current and Needed Research and Development. It presents issues attendant to research and development in cognitive styles and microcomputer uses within the context of instructional technology. The paper discusses issues of relationship of cognitive style to learners' general ability and prior learning. In discussing needs for research in and on microcomputers in education, the paper discusses the heritage of programmed instruction and teaching machine research of the 1950's and 1960's, as that work relates to currently available practitioner's tools in instructional design and development. A plea is made for increased basic research on learner characteristics and instructional media attributes of currently available high technology.

CONCEPTUAL TOOLS FOR R & D ON APPLICATIONS OF
MICROCOMPUTERS TO INDIVIDUALIZATION

INTRODUCTION

This symposium is about research and development in microcomputers and cognitive styles. A substantial amount of research has been conducted regarding individual differences in receiving and processing information, generally referred to as "cognitive styles" (such as field independence - dependence, leveling - sharpening, and impulsivity - reflectivity). On the other hand, little research is available regarding how the unique attributes of computers may be used to adjust instruction to accomodate individual differences, including cognitive styles. Particularly missing is research on microcomputers in instruction from a theoretically grounded framework. The symposium will clarify major research issues attending these topics within theoretical frameworks provided by cognitive styles. The symposium will provide information on current work and work which needs to be done. The symposium consists of four papers: 1. conceptual tools, 2. instructional design, 3. measurement, and 4. instructional management.

The first presentation, Conceptual Tools, is my own. That presentation will be a general essay on the topic at hand and should serve as orientation for the three papers to follow. Patricia Smith will discuss instructional design issues, Robert Burroway will discuss measurement potentials, and Barbara McCombs will discuss instructional management issues. Our discussants today are Perrin Parkhurst and William Winn. Dr. Ron Burkett, originally to be a discussant, was unable to attend and Bill Winn has graciously agreed to be a discussant in his place.

As a review of this overview, I want to restate: our topic here

is the existing and needed research and development in an area of interest created by the combination of cognitive style and microcomputers. After my "Conceptual Tools" presentation, we will take three slices through this topic. We will look at it in terms of instructional design, measurement, and instructional management.

COGNITIVE STYLES

You never know what a person is going to be talking about when he says he is going to talk about "cognitive styles." He might have in mind the "educational cognitive style" or "cognitive style mapping" of Joe Hill or of Kenneth and Rita Dunn's work in this area. Or he might be talking about only the work begun by Herman Witkin and his associates on field independence/ dependence. Or he might be talking about a variety of non-academic learner differences in perception and information processing, as we will. These include not only field independence/ dependence, but also such things as leveling/ sharpening, impulsivity/ reflectivity, visual/ haptic, distractibility, breadth of categorization, scanning, tolerance for unrealistic experiences, cognitive complexity/ simplicity, and conceptualizing styles, to name ten. We, in this symposium, will be talking primarily from this latter frame of reference: those dimensions of individual difference which have been found and labeled as a product of systematic study of differences in the way people perceive and process information.

Another way in which people who talk about "cognitive style" differ among one another is with regard to their "purity." Some people are very pure, probably the purest being those who restrict their discussions to only field independence/ dependence. That is a "pure" thing to do because, first, field independence/ dependence is

the one which first used the term "cognitive style," and second, because the other style dimensions in my list of ten are actually called things like "perceptual style" in the case of visual/ haptic, "cognitive tempo" in the case of impulsivity/ reflectivity, and "cognitive controls" in the case of leveling/ sharpening.

The least purity, in my view, is found in the "educational cognitive style" and "cognitive style mapping" formulations. For all I know, there may be something to educational cognitive style inventories and the educational prescriptions derived from them, but I cannot find it. Although there is nothing perfect about the more "pure" approaches to cognitive style, there has been, to my knowledge, no establishment of validity to the instruments used by educational cognitive style proponents. In addition, it seems inappropriate and downright invalid to dispense free and easy prescription of broad classes of treatments regardless of learning task, such as: "Well, you are auditory and kinesthetic, so you will learn best from listening and getting in direct touch with things." Such prescriptions smack more of the reading of gypsy tea leaves than of scientific study of instruction or of a technology of instruction.

As you might be able to tell from the forgoing, my own purity quotient and that of the participants in this symposium is about in the middle. In other words, we are purer than some but not as pure as others. None of us restrict our interest to field independence/ dependence on the one hand, and on the other hand none of us can see much value to the Hill, Dunn and Dunn, and other formulations of educational cognitive style. In sum, we do believe that there are a variety of "non-academic" individual differences which are **real** and **relevant** to instructional theory development.

What do we mean by "non-academic" learner differences? I use this term because it is the best thing I can think of to differentiate between what I have in mind and two powerful influences on learning from instruction which are **not** what I have in mind: general ability and prior learning. General ability and prior learning are both academic learner differences. In the case of general ability, the factor is an academic one because of the fact that all measures of general ability are validated in terms of prediction of ability to do school work, and prior knowledge is an academic variable because the prior knowledge of interest is generally in or related to the desired learnings at hand.

General ability and prior learning share one thing in common and are in another regard at opposites to one another. General ability and prior learning share in common a profound influence on learning from instruction. On the other hand, they are qualitatively different factors with regard to the precision with which they can be described and measured and the precision with which we may think about them. We know practically nothing, I would submit, about general ability, except that it must exist and that it varies. Prior learning, on the other hand, is the foundation upon which our most powerful and clearly understood principles of instructional design rest.

In the domain of **non-academic** learner differences lie many factors, among which cognitive styles represent the most-studied. In papers to follow, we will be looking at and thinking about existing and needed research in instructional technology which includes cognitive style.

Before I leave the topic of cognitive style, I want to note that for those of you interested in an extensive treatment of cognitive

styles and their impact on learning from instruction, I can make available to you a set of technical report reprints from a three year basic research contract in this area, sponsored by the Air Force Human Resources Laboratory. I was Principal Investigator of that project which includes work which Ausburn and Ausburn did under me as doctoral students at the University of Oklahoma, as well as extensions of that work by them, others, and myself. The Air Force has long since run out of stock of these reports, and since they amount to over 250 pages, I cannot supply them for free. However, if you are interested in receiving them, please come and talk with me at the conclusion of this session.

MICROCOMPUTERS

In the 1950's and 1960's, an enormous amount of research and development was conducted on and with teaching machines and programmed instruction. The teaching machines fad has passed, but it left us with a substantial residue. It is through discussion of this residue that I would like to orient our thinking about instructional technology research involving microcomputers and finally, to both microcomputers and cognitive style.

In my view, the lion's share of our practitioner's tools in instructional technology, including such things as learning task analysis and our models of instructional design and development, are essentially residue from the research and development with teaching machines and programmed instruction. For example, the feedback loop in all our I/D models -- in which we take information about learner's performance after instruction and re-inject that into the system as feedback to improve future instruction -- is **essentially** a generalization of the programmed instruction maxim that "thou shalt

validate thy program." Instead of just having a critical reader, an expert in your field, review and make editorial judgements about whether the text **seems** clear and about whether or not learners **should** be able to learn from the material, a procedure which quickly became standard practice in programmed instruction development was to actually **try out** the material with learners to see if it worked. We are so accustomed now to the idea of empirical validation of instructional materials and so accustomed to improvement of materials of all sorts through use of information about their effectiveness, that it is easy to forget where these ideas came from. Little more than twenty years ago these were radical innovations, part of the programmed instruction movement.

Programmed instruction represented our first instance of thinking about an **instrument of instruction**, rather than a medium or aid. The reality of this instrument, this **thing**, that was supposed to teach somebody something, focused the minds of educational developers in new ways. Since an instrument is supposed to teach something, all by itself, developers realized that they had to decide on and describe pretty clearly what that something was. Such was the beginning of behavioral objectives. It is amazing that a tool developed for the express purpose of facilitating development of programmed instruction materials has seen such widespread use over such a long period of time.

In 1967, Arthur Lumsdaine's classic review of research in our field up to that time appeared in the first edition of the Handbook of Research on Teaching, edited by N.L. Gage. That review was entitled "Instruments and Media of Instruction," and in it, Lumsdaine noted that the most significant thing about programmed instruction was its

quality of representing a reproducible, self-contained instrument of instruction, and as such it offered a uniquely powerful handle on research. Looking back I think he was right. He was so right, in fact, that the influence of research and development with programmed instruction continues to the present and remains a dominant influence in our current practitioner's tools. When you or I are frustrated with the state of the art of instructional design, when we find that the models we use have a distressing number of "empty boxes" at critical places, such as "devise instructional strategy," what we are essentially frustrated with is models which are extensions of what was learned from research and development with programmed instruction and teaching machines. This is, I am sure, an arguable point but it is certainly how it looks to me. If I am correct, or even half-correct, no wonder state of the art in I/D is beginning to look awfully old, awfully tired, and awfully in need of replacement or supplantation with something new, different, and "better."

It is not that no water has gone under the research and development bridge since the heyday of of programmed instruction. We have new insights into cognition and human information processing, new intrests in the study of instructional media attributes, learning strategies employed by learners themselves, and, in short, a large number of new questions and theoretic insights. All the new directions and good work over the past twenty years notwithstanding, it appears to me to **remain** the case that if you are in a school or training setting and you want to do instructional development with the most learning payoff per dollar spent, you should spend your time and money on development of the best single-track instructional materials that you can design and develop. And although we know that a single

set of materials can be themselves adaptive to individual differences, it is on the very question "on what bases will we design for adaptive qualities in our materials?" that our high level designer-based answers become common sense at best and weak or foolish at worst. Operationally, our instructional theory is the heritage of what they were doing in the 1950's and 1960's. My own first publication, incidentally, was in 1961, it was about teaching machines. Its title was "Hardware and Hard Work" and it essentially outlined a great deal of what people are worrying with right now in the development of computer assisted instruction materials. We **should** be, I submit, worrying about qualitatively different things...the sorts of things represented by our current research and current instructional tools.

We do have today, knowledge and tools we didn't have back then. Among those new tools are increased knowledge of some non-academic individual differences in perception and information processing which we call "cognitive styles," and we also have a new device: the microcomputer. Although neither of these things are trivial in themselves, I think it is fair to say that we really do not yet know what to do with either one. If that is an overstatement, I will rephrase to: we don't have a body of systematic knowledge lending prescriptions to instructional designers which involves consideration of human information processing, including cognitive styles, or of many current instructional media attributes, including those of microcomputers. Our best practitioner's tools in instructional technology rest on the behaviorist school of learning theory and upon the instructional media attributes of teaching machines and other media available twenty years ago.

I hope the microcomputer is a technology which will stimulate

research and development in instructional technology, much in the same way that teaching machines did twenty years ago. I hope microcomputers force researchers to re-examine fundamental tenants of instructional design and development. It is obvious, I think, that microcomputers are being put to trivial uses when they are used to emulate a teaching machine or programmed text. What we have left, when you take away page-turner applications of microcomputers, is a mixed bag of powerful and trivial uses for which our instructional design models end up more or less naked. Naked. I like that metaphor...it seems to fit..."microcomputers have caught us with our pants down." You may quote me on that.

We need, it seems to me, two things: one is heavy, widespread involvement by instructional technology researchers into programmatic, basic research on and with high technology, including microcomputers, and learner characteristics which interact with instructional treatments. This research will not, as Prof. Gerlach noted in an earlier session, provide practitioners with answers, certainly not quickly. But second, we can and should expect to see, at some point, appropriate and useful synthesis of our more current knowledge. To put it concretely, we will need a Robert Gagne to sift, interpret, synthesize, and model the best of current knowledge.

If we, today's researchers in instructional technology, do what they did in the 1950's and 1960's, we will begin responding to the unique attributes of microcomputers with the best theory available and begin to formulate research and development which may ultimately become far more significant and useful to education and training than the machines themselves ever were.

These then are our topics: cognitive styles and microcomputers.

You may think of our topics, in the final analysis, as being examples of what is really at stake. The papers to follow will take their **material** from cognitive styles and microcomputers; what the papers are **about** is much broader. I expect that the symposium will give you ideas you can use in your thinking about research in our field and, what I hope this paper and the symposium as a whole will do is provoke you to think about the **possible** in new and different ways.